Multiple Spectral Components in Nearby Radio Galaxies

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The ASCA observation of NGC 6251 returned significant spectral data, and are showing that the interpretation of NGC 6251 which we based on earlier ROSAT spectra needs modification.

A simple power-law fit to NGC 6251, using all the GIS and SIS data, produces a good reduced chi-squared (0.97; 749 degrees of freedom), but between 1 and 2 keV there is a significant pattern of residuals in both detectors which suggests that the fit is imperfectly describing the spectrum.

A superposition of a power law spectrum and a thermal spectrum, which was the model most favored by our ROSAT data, produces an adequate (but worse) fit, with reduced chi-squared 1.03 (745 degrees of freedom), and only small changes in chi-squared are obtained as the abundance varies.

An excellent fit (reduced chi-squared = 0.94, 747 degrees of freedom) is produced by an alternative model based on the ROSAT data, where two thermal components make up the X-ray spectrum. The pattern of residuals is much superior to that found with the power-law spectrum. If the abundances are allowed to fall to 0.3 cosmic, then even better fits are produced (reduced chi-squared of 0.90)

All these fits require absorption above the galactic value, and the best of them appear to involve both a cool and a hot component of thermal gas (though the hot component can be replaced by power-law emission with only a modest cost in goodness of fit). The excess absorption is consistent with the neutral hydrogen column that we found with the VLA, so that a consistent picture of a cool atmosphere and an absorbing column near the central source is emerging. What is not clear at the moment is whether the central object is principally non-thermal emission (a mini-AGN) or thermal emission (a hot bubble or corona of a disc or cloud).

Further comparisons of the X-ray data from ASCA and ROSAT, including joint spectral fitting and absorption data from the VLA studies, may resolve this scientific issue. We also plan checks of the result using a wider variety of fitting codes, since there are well-known problems in interpreting structures in X-ray spectra due to model uncertainties in the line emission from atomic species in astrophysical objects.